CLAIMS

We claim:

1. A method of forming a high concentration borophosphosilicate glass layer on a substrate, the method comprising:

providing a substrate in a chamber;

providing a silicon source, a oxygen source, a boron source and a phosphorous source into the chamber to form a high concentration borophosphosilicate glass layer on the substrate; and

reflowing the high concentration borophosphosilicate glass layer formed on the substrate.

2. The method of claim 1 further comprising cooling the substrate for a predetermined period of time following reflowing the high concentration borophosphosilicate glass layer formed on the substrate.

3. The method of claim 1 wherein the high concentration borophosphosilicate glass layer comprises about 2-7 weight percent boron and about 2-9 weight percent of phosphorous.

4. The method of claim 1 wherein a combined weight percent of boron and phosphorous present in the high concentration borophosphosilicate glass layer is about 10-12 weight percent.

5. The method of claim 1 wherein providing the silicon, oxygen, boron and phosphorous sources into the chamber to form the high concentration borophosphosilicate glass layer on the substrate is performed at a deposition temperature in a range of approximately 300-600 °C.

6. The method of claim 1 wherein reflowing the high concentration borophosphosilicate glass layer is performed at a reflow temperature in a range of approximately 600-1050° C in an ambient selected from the group consisting of dry

ambient, steam ambient, water ambient and ambient formed by in-situ reaction of H_2 and O_2.

7. The method of claim 1 wherein the silicon source is TEOS.

8. The method of claim 1 wherein the oxygen source is O_3.

9. The method of claim 1 wherein the boron source comprises TEB.

10. The method of claim 1 wherein the phosphorous source comprises TEPO.

11. The method of claim 1 wherein the high concentration borophosphosilicate glass layer fills at least one trench contained in the substrate having an aspect ratio of about 7:1 to 10:1.

12. A method of forming an insulating layer on a substrate, the method comprising:

providing a substrate in a chamber;

providing a silicon source, a oxygen source, a boron source and a phosphorous source to chemical vapor deposit a high concentration borophosphosilicate glass layer on the substrate;

forming a second insulating glass layer of undoped silicon glass over the high concentration borophosphosilicate glass layer; and

reflowing the deposited high concentration borophosphosilicate glass layer on the substrate.

13. The method of claim 12 wherein the high concentration borophosphosilicate glass layer comprises about 2-7 weight percent boron and about 2-9 weight percent of phosphorous.

14. The method of claim 12 wherein a combined weight percent of boron and phosphorous present in the high concentration borophosphosilicate glass layer is about 10-12 weight percent.

15. The method of claim 12 wherein reflowing the high concentration borophosphosilicate glass layer is performed at a reflow temperature in a range of

approximately 600-1050° C in an ambient selected from the group consisting of dry ambient, steam ambient, water ambient and ambient formed by in-situ reaction of H_2 and O_2.

16. The method of claim 1 wherein the silicon source is TEOS flowing in the chamber at a rate of about 200-1000 milligrams per minute.

17. The method of claim 1 wherein the boron source is TEB flowing in the chamber at a rate of about 100-300 milligrams per minute.

18. The method of claim 1 wherein the phosphorous source is TEPO flowing in the chamber at a rate of about 10-150 milligrams per minute.

19. The method of claim 1 wherein the oxygen source is O_3 flowing in the chamber at a rate of about 2000-6000 standard cubic centimeters per minute.

20. The method of claim 1 wherein the high concentration borophosphosilicate glass layer is formed in the chamber at a rate in a range of approximately 2000 to 6000 Å/min.

21. The method of claim 12 wherein the second insulating glass layer has a thickness in a range of approximately 100 to 200 Å.

22. A method of depositing an insulating layer on a substrate having at least one trench, the method comprising:

chemical vapor depositing a high concentration borophosphosilicate glass layer over the substrate by providing TEOS, O_3, TEB and TEPO into a chamber at a deposition temperature of about 300° C. to 600° C. and a sub-atmospheric pressure of about 60 to 750 torr, the high concentration borophosphosilicate glass layer comprising less than or equal to about 7.0 weight percent boron and less than or equal to about 9.0 weight percent of phosphorous for a combined boron and phosphorous concentration of about 10-12 weight percent; and

reflowing the deposited high concentration borophosphosilicate glass layer at a reflow temperature in a range of approximately 600° C to 1050° C to fill the at least one trench in the substrate with the high concentration borophosphosilicate glass layer.

23. The method of claim 22 wherein the at least one trench has a high aspect ratio of about 4:1 to 10:1.

24. A substrate processing system comprising:

a substrate holder located within a chamber;

a gas delivery system to introduce a reactant gas mix into the chamber to deposit an insulating layer over the substrate;

a pump coupled to a gas outlet to control the chamber pressure;

a rapid thermal anneal system to reflow the layer deposited over the substrate;

a controller to control the gas delivery system and the pump, the controller further to control the rapid thermal anneal system; and

a memory coupled to the controller comprising a computer-readable medium having a computer-readable program embodied therein to direct operation of the substrate processing system, the computer-readable program comprising:

instructions to control the gas delivery system to introduce a reactant gas mix including a silicon source gas, a boron source gas, a phosphorous source gas and a carrier gas into the chamber to deposit a high concentration borophosphosilicate glass layer over the substrate positioned on the substrate holder, the instructions further to control a temperature of the reflow to enable the deposited high concentration borophosphosilicate glass layer to fill a trench in the substrate.

25. The substrate processing system of claim 24 wherein the high concentration borophosphosilicate glass layer has a boron concentration in a range of approximately 2-7 weight percent and a phosphorus concentration in a range of approximately 2-9 weight percent for a combined boron and phosphorous concentration of about 10-12 weight percent.

1 26. The substrate processing system of claim 24 wherein the reflow is performed at
2 a reflow temperature in a range of approximately 600-1050° C in an ambient selected
3 from the group consisting of dry ambient, steam ambient, water ambient and ambient
4 formed by in-situ reaction of H_2 and O_2.

1 27. The substrate processing system of claim 24 wherein the trench has a high
2 aspect ratio of about 4:1 to 10:1.